

**RED FIRE APPARATUS:  
AN ACCIDENT WAITING TO HAPPEN,  
OR JUST A GOOD FINANCIAL DECISION?**

FINANCIAL MANAGEMENT

BY: Brian Sorensen  
Omaha Fire Department  
Omaha, NE 68102

An applied research project submitted to the National Fire Academy as part of the Executive Fire Officer Program

June 2001

## **ABSTRACT**

Fire Departments around the country order fire apparatus on a regular basis. The questions of what type of apparatus, what vendor, and what special equipment to order are always asked. However, the question of what color or color combination of apparatus does the fire department order is often asked. This one question has raised controversy among department members, city fathers, and even citizens in many communities. One of the most controversial statements was said in the early 1970's by Dr. Solomon that the color red is less visible, thus making the red apparatus more prone to accidents. The purpose of this research project was to conduct an in-depth study into the area of the color of red and its use on fire apparatus, and to provide recommendations for making fire apparatus less prone to accidents.

Action research was used by this author. The following research questions were asked:

1. What colors are commonly used for fire apparatus?
2. What financial benefits do fire departments gain by using the color red as opposed to other colors?
3. Is the color red a possible cause for accidents, or are there other causes which fire departments should address?
4. What new technology exists to make fire apparatus more visible?

The procedures used to complete this research project consisted of a records review, a literature review, personal interviews with prominent fire department officials around the United States, and the use of a survey instrument sent to fire departments around the world.

The results of this research include:

- The substantiation of some past research and new data to support that some past research is flawed.
- Consensus standards used to guide fire departments and fire apparatus manufacturers in building fire apparatus.
- The examination of new technology used to provide better visibility for fire apparatus.
- The financial reward gained for painting the fire apparatus red.

The recommendation of this research project include the support for painting the fire apparatus red for financial reasons, the use of a certified emergency operators training program, and the use of reflective and state-of-the-art warning devices.

## TABLE OF CONTENTS

	<b><u>PAGE</u></b>
Abstract.....	2
Table of Contents.....	4
Introduction.....	5
Background and Significance.....	6
Literature Review.....	8
Procedures.....	16
Results.....	19
Discussion/Implications.....	22
Recommendations.....	25
References.....	27
Appendix A: Breakdown of Colors used in the Fire Service By Prominent Fire Apparatus Manufacturers.....	28
Appendix B: Colors of Apparatus Sold in Oregon in 1991.....	29
Appendix C: Omaha Metropolitan Area Fire Dept. Apparatus Colors.....	30
Appendix D: 3M Government Vehicle Reflective Marking Tape.....	31
Appendix E: City Survey Questions.....	32
Appendix F: City Survey Responses.....	33
Appendix G: Recommendations.....	34

## INTRODUCTION

When fire department managers order fire apparatus, the issue of color will usually arise. It will make no difference whether they are currently using apparatus painted red, or any other color. The terms visibility, safety, resale value, and warning devices are often heard. Fire departments are also facing tighter budgets each year. To order a red fire apparatus could mean a significant monetary gain when the city puts the unit up for resale after many years of use. However, questions about safety and visibility still arise. The problem is how does painting a fire apparatus red affect the visibility, accident rate, and the financial impact to the department.

The purpose of this research was to conduct in-depth research into the area of the color red and fire department apparatus accidents, and to provide recommendations for preventing apparatus accidents. This researcher will use active research. The following research questions were asked:

1. What colors are commonly used for fire apparatus?
2. What financial benefits do fire departments gain by using the color red as opposed to other colors?
3. Is the color red a possible cause for accidents, or are there other causes which fire departments should address?
4. What new technology exists to make fire apparatus more visible?

## **BACKGROUND**

Fire Departments around the world order new apparatus every day. Many department leaders and managers ponder the question, what color of paint or what multiple color combination is the apparatus to be painted? Fire apparatus have been traditionally painted red since the early 1900's. Of course, there has been a variation of colors for many reasons. Those reasons were personal preference, a specialty color representing a private company or industry, or the city colors.

In the mid 1970's, Dr. Soloman (1974) stated in an article that lime-green and lime-yellow grab the attention of the viewer more quicker and uses his medical background to prove his theory. The federal government adopted this philosophy in the mid 70's and made it part of the National Fire Protection Association (NFPA) consensus standards for fire apparatus to make the color of all new fire apparatus the lime-green and lime-yellow. This code lasted a couple of years and was then removed from the standard, not making any special recommendations for fire apparatus color to this date.

As a result of the standard change, fire departments throughout the country changed the color of the apparatus to lime-green or lime-yellow, or the color of all new apparatus were ordered as a result of the NFPA change. Two of those departments are the Omaha Fire Department and the Detroit Fire Department. The Omaha Fire Department went to a bright yellow color and the Detroit Fire Department went to lime-green.

The Omaha and Detroit fire departments are currently going back to red fire apparatus for various reasons. Some of these reasons are tradition, lack of substantial data to back up Dr. Soloman's concept, new technology for better visibility, and for financial reasons.

The NFPA currently has consensus standards that address the issues of fire apparatus safety that effect the area of emergency vehicle operation. The consensus standard NFPA 1901 places emphasis on emergency light emissions and emergency light placement on the apparatus. NFPA 1451 places emphasis on emergency vehicle training programs. While NFPA 1002 places emphasis on emergency vehicle operator qualifications. The adherence to these consensus standards will increase the safe operation of all fire department vehicles.

New technology exists in light emission devices and in reflective qualities of materials, thus eliminating the need for brighter, and more visible colors. The high output of halogen lights, strobe lights, and LED (light emitting diodes) technology are making fire apparatus more visible than apparatus of the 1970's.

As city budgets become tighter and the citizen demand for lower taxes continue nationwide, fire department managers are constantly seeking better ways to trim the fire department budget. One way is to obtain a higher resale value for the fire apparatus when the department brings in new equipment and the puts the old equipment on the market for resale. A review of current production colors by prominent manufactures of fire apparatus (App A) shows what color is prominent in the fire service. Today, the market demand is for red fire apparatus. As the demand increases, the unit will be easier to sell. Other colors will bring lower resale prices on the open market.

It is the responsibility of all Executive Fire Officers on all fire departments to recognize these values and standards. The following research will explore the areas vital to choosing fire apparatus color.

## **LITERATURE REVIEW**

Research on fire apparatus color and emergency vehicle safety and operations was done using the National Fire Academy Learning Resource Center (LRC) located in Emmitsburg, Maryland. Use of the card catalog through the Internet proved to be a valuable resource. Librarians at the Sump Memorial Library in Papillion, NE assisted in the interlibrary loan. Specific items unique to other fire departments and businesses were gathered by telephone interviews and correspondence through the US Mail.

### **Colors commonly used for fire apparatus**

Most fire apparatus have been painted some variation of red since the early 1900's. If a person were to visit museums or look for books ,especially children's books, in the library about fire fighting, the color red is seen the most as the choice for fire apparatus color.

A survey of fire apparatus manufactures by Dale Kamrath (1991) showed that 70% of the fire apparatus manufactured in 1991 were painted red (App. B). The lime-green and lime-yellow colors were used 10%, white 10%, and all other colors 10%. In 2001, the most common color is red (App. A). However, the percentage of red has increased to over 85%. Other colors, including lime-green, lime-yellow, white, black and all others make up the last 15%. A survey of a two-county area around Omaha, NE confirms the manufactures survey (App. C) numbers and that red is the color of choice for this local region. The trend of consumers across the United States to purchase red fire apparatus has significantly increased.

### **What financial benefits do fire departments gain by using the color red as opposed to other colors?**

As the President of United States looks for ways to decrease spending, so will the local elected officials. As a result, executives in the fire service must examine their budgets and find



ways to decrease spending, and/or ways to increase revenue without raising taxes. One such way to decrease spending is to buy used fire apparatus.

Many rural fire departments in sparsely populated areas of the United States have a very small tax base. To buy a \$250,000 fire apparatus is not a realistic budget item. To overcome this problem and still update the equipment, the departments purchase used equipment from other departments and dealers.

According to Jeff Mellen (personal communication, January 12, 2001), President of EDM Equipment (E-One distributor), "There is a significant difference in what we are able to offer as a value of red versus other color apparatus trading another unit in. Obviously this would depend upon factors such as year, make, etc. However, in instances where the trade is a color other than red, we generally figure a deduct amount equal to the cost of repainting the entire unit, or 1/3, whichever is more. Accordingly, red trucks would hold their resale value better than other colors." If a fire department buys a red fire apparatus and sells or trades on a regular basis, a significant financial gain can be re-directed into the fire department budget. Fire chiefs and other Executive Fire Officers will be well received by city administrators.

In Detroit, Michigan where the prominent color of fire apparatus has been lime-green since the 1970's, the department is in the process of returning to the color red. According to Ivan Ozment (personal communication, May 16, 2001), Superintendent of Apparatus, who has 24 years with the Detroit Fire Department, the visual appearance of the lime-green deteriorates faster than the red. "The lime-green fades much quicker and all dents and scratches show more. The cost and upkeep of the lime-green more costly than the red." Ozment went on to explain that the Detroit Fire Dept. does not gain financially from the resale of the fire apparatus, as the department uses the apparatus until it is worn out and is of little value.

The Omaha Fire Department is also changing apparatus color from yellow to red. The color changing process is gradual and will take place over the next 15 years. All new apparatus will be painted a combination of red and white. Once again, the main reason given for change, according to Assistant Chief Joe Cisler (personal communication, May 5, 2001), “Is for financial reasons.” The resale value of the apparatus will have a positive influence on future budgets.

**Is the color red a possible cause of accidents, or are there other causes which fire departments should address?**

The color red has never been officially, or scientifically recognized as a cause for accidents. To the contrary, there are articles which substantiate red as a warning color.

Dr. Stephen Soloman (1974) discusses the pro’s and con’s of various colors. Included in this article is scientific information related to color recognition, as well as Dr. Soloman’s own personal views.

Dr. Stephen Soloman (1990) discusses various colors and the relationship the colors have in different lighting situations and conditions. The perceptions of colors are also discussed. The colors of red and orange are recognized as warning and safety colors (p. 828).

Rossman P.C. (1995), an attorney in Boston , Massachusetts, states “...the most likely source for injury or death in connection with your fire department duties involves a traffic accident responding to or returning from an incident” (p. 15). He also states that Executive Fire Officers should be aware that, “...the greatest chance of being named in a lawsuit in connection with your fire department duties is out of your operation of the emergency vehicle” (p. 15).

Wilbur (1994) covers the liability of fire departments that incur when a fire apparatus drives down the street. According to Wilbur, training is imperative. Pro-active driver’s training and the use of a formal driver’s program with complete documentation are very important.

The National Fire Protection Association (NFPA) is an international non-profit organization that annually reviews and updates all standards that pertain to fire safety, firefighter clothing specifications, fire apparatus specifications, and fire apparatus operator training, etc. This standard presents the minimal requirements in those areas and is usually enforced at the state level. The NFPA standards are meant to be used in conjunction with each other to form a safe and effective fire department.

*NFPA 1002, Standard for Fire Apparatus Driver/Operator Professional Qualifications* (1998) is a document which sets job performance standards. These standards pertain to drivers of fire apparatus. By following and/or exceeding these standards, the goal of safe operation of fire apparatus may be achieved.

NFPA 1451, *Standard for a Fire Service Vehicle Operations Training Program* (1997), dictates, "...the development, implementation, and periodic review of standard operation procedures for driving any fire department vehicles is an important element in clearly identifying the fire department's policy on what is expected of drivers" (p. 1451-4). Safety is the major issue in this standard. The policy states, "Fire department members shall be trained to operate specific vehicles or classes of vehicles before being authorized to drive or operate such vehicles" (p. 1451-5).

NFPA 1901, *Automotive Fire Apparatus* (1999), is a standard meant to guide fire apparatus manufacturers and fire department officers in the designing and manufacturing of fire apparatus. There is no mention of fire apparatus color in this standard. However, warning devices and the light reflective qualities of the apparatus are covered. A horizontal strip made-up of a 4" minimum width of reflective material must completely encircle the apparatus. The standard also

provides the minimum candelas required that the fire apparatus must emit when responding to an emergency.

### **What new technology exists to make fire apparatus more visible?**

Technology has improved immensely since the 1970's. The days of single incandescent sealed beam warning devices have given way to advanced technology involving halogen, strobe, and LED (light emitting diode) light devices.

According to Ken Menke Jr. (personal communication, May 7, 2001), President of the Fire Service Research Institute, President of Power Arc, Inc., and member of the NFPA committee which researched and wrote the NFPA 1901 standard, states, "The adherence to the standard can result in a very visible fire apparatus when responding in the emergency mode. The color amber is a society standard for precautionary color. The color red is a warning color." According to Menke, the use of the color red, blue, and white are the best combinations of warning lights. It must be noted that the color blue is perceived at night more quickly because it is brighter than red. By using blue, the attention of the citizen is gathered sooner, thus making them aware of the red lights, indicating warning and alerting them to the presence of the emergency vehicle. Menke (personal communication, May 7, 2001), added, "The most effective light source is from multi-colored systems."

Menke, also talked about the pros and cons of various light systems. Strobes are very bright lights. The brightest strobe color, other than white, is blue. It must be noted that the life expectancy of a strobe light is approximately the life-time of the apparatus. However, the strobe will begin to weaken over time and for that reason the effectiveness of the light will be decreased. It will not fail, but will become weaker and may not be replaced when it is less effective because the unit is still working. For this reason it is recommended the strobe be

replaced every 5 years. In addition, the flash rate on a single strobe is no faster than 75 flashes per minute. The NFPA 1901 standard states that, "...a minimum of 150 flashes per minute shall be present at any flash point (p. 1901-26).

Halogens are another light source and warning device and provide a very bright light. The halogen light will only lose 10 – 15% of the light output before failing. For this reason, it is a better light source than a strobe. The halogen bulb can be used as single light source, being rotated or reflected to provide the minimum 150 flashes. By varying the rate of rotation, the flash rate can be increased or decreased. Menke (personal communication May 7, 2001), states, "The optimum flash rate for a halogen light is 200 flashes per minute."

Care must be taken to stay within the voltage recommendations of the apparatus defined in NFPA 1901 (p. 1901-25). LED technology is a very new technology and is a low voltage system. The diodes draw very little power and have a life expectancy of the apparatus. As science advances in this area, better lighting for fire apparatus will follow.

The 3M Corporation has developed reflective materials that adhere to the fire apparatus and provide a minimum retroreflective brightness in a range of 30 – 100 candelas/lux/sq m (<http://www.3m.com>). NFPA 1901 (1999) states that all fire apparatus shall have a four inch band of reflective material placed around the entire vehicle. The reflective qualities of the material range from white being the brightest to black having approximately one-third the retroreflective brightness (App. D). Selective color combinations and using the white reflective tape will enhance the visibility of the fire apparatus.

Technology has advanced throughout the years. However, Menke (personal communication May 7, 2001) states, "Nothing compensates for good driving." Because front-end collisions are

very rare, and most accidents involve T-bone, side, or rear-end collisions, the accident cause is labeled more as driver error as opposed to a visibility problem.

**Informational Survey gathering information about apparatus color, driver's training, runs in 1999, number of accidents in 1999, and the accident-per-run percentage**

A survey was sent to 18 fire departments (App. E). Twelve departments responded to the survey. The participating cities represented large and small cities from all geographic areas of the United States and one response from Queensland, Australia (App. F). Eighty-three percent (10/12) of the departments operated with red fire apparatus. Yellow and white make-up the remaining 17% (2/12). A certified Emergency Vehicle Operator (EVO) class is given in 83% of the departments with on- going continuing education. The accident rates were the highest in departments with no EVO classes.

The Birmingham, AL Fire Dept. has yellow fire apparatus. Prior to 1997, the department averaged three accidents per year. In 1997, the department implemented an EVO course. The accident rate has dropped to 0%. The color of the apparatus remains yellow.

To further verify the results of the survey, Commander Mike Kovac (personal communication, May 7, 2001), head of the Chicago, IL Fire Department Training Bureau was contacted. He has 36 years with the Chicago Fire Dept. and has been a driver of fire apparatus for 28 of those years. He states, "...the majority of accidents are not caused by a lack of skill. Accidents are caused by *a lack of attitude.*"

According to Kovac, this point was qualified by a training exercise on the Chicago Fire Dept. A fire apparatus driver was having an increase in accidents over a one year period. The administration failed to take any disciplinary action. The training bureau intervened with classes given to all drivers of that apparatus on all shifts. Since the date of completion of the EVO class,

that particular fire station has been accident free. Kovac (personal communication, May 7 2001) states, "No mechanism for discipline for driving accidents, leads to a lack of attitude and more accidents." According to Kovac, the Chicago Fire Dept. has a position for a full-time emergency vehicle operator instructor, but is not staffed due to financial constraints. For the month of December 2000, 112 accidents were recorded. At this rate, the City of Chicago could have over 1,300 accidents in the year 2001. Could the cost of repairs of these accidents off-set the cost of a full-time driver's trainer? Is there more money in the lawsuit fund than the training bureau budget for driver education? Emergency vehicle operator training is indeed another aspect to driving the fire apparatus safely.

The literature reviewed by this researcher is limited in the area of color for fire apparatus. However, the availability of research materials in the area of vehicle operations and safety is more prevalent. The use of all of these other sources adds to an overall knowledge base to which this researcher could find successful results. From these results, sound recommendations were made.

## **PROCEDURES**

This research project used the action research methodology to:

- a) Research colors commonly used by fire apparatus manufactures.
- b) Research all standards that apply to emergency vehicle manufacturing, operation, and training.
- c) Research new technology used to make fire apparatus more visible.
- d) Survey fire departments from around the world and find what color of apparatus are used, if they have an EVO program in place, number of runs in 1999, and the number of accidents in 1999.

The procedures used to complete this research included a literature review, a review of consensus standards, personal interviews with recognized experts, and a survey of fire departments around the country to find information about fire apparatus color, training, and fire apparatus accident information.

### **Literature Review**

The literature review was initiated using the Internet to gain access to the on-line card catalog at the National Fire Academy on March 4, 2001. Research continued at the University of Nebraska at Omaha Library in Omaha, NE and at the Sump Memorial Library in Papillion, NE.

The review examined trade journal, NFPA standards, safety and health manuals, Applied Research Projects, and data books from the U.S. Fire Administration. Relevant sources were reviewed, summarized, and included in the literature review.

### **Personal interview with recognized experts**

During the month of May interviews with several experts in the area of fire apparatus maintenance, fire apparatus driver training, and the area of light emission were conducted. These



interviews provided valuable insight to lend credibility to the data which the surveys found. Even though these experts are not published, the length of time in their area of expertise and the amount of equipment and number of personnel they train give credibility to the information presented.

**Informational survey used to acquire data from fire departments on fire apparatus color, EVO training, runs per year, and accidents involving fire apparatus in 1999.**

An informational survey was sent to fire departments around the United States and Australia (App. E). Questions were asked about fire apparatus color in their city, do they have an Emergency Vehicle Operator (EVO) training program, number of runs/incidents in a 1999, and the accidents where their fire department vehicles were involved in 1999.

The cities were chosen at random. Locations of the cities were to be from various regions of the country to eliminate weather patterns and geographical patterns. The questions were to be simple and not to allow a variable answer. The data would be easily available from fire department annual reports. Eighteen surveys were sent out by email to the department contacts. Twelve were returned. The response rate was 66%.

The color red was the color of choice for eleven out of twelve departments. Seventy-five percent of the responding departments had an EVO training program. Data was collected about the total runs in 1999 and also data was collected for the number accidents their fire department vehicles were involved in 1999.

**Assumptions**

This author collected all literature, data, and statistical data with the thought that all authors and recognized experts were truthful and factual in their answers. It is assumed that all participants in the survey provided accurate data about their fire departments vehicle color, EVO

programs, run numbers, and the number of fire apparatus involved in accidents for the survey time period.

### **Limitations**

Limitations that effected this research project were time, availability of a more comprehensive and detailed data base about fire department EVO programs, fire department apparatus color, and individual fire department accident rates. The assumption that all respondents of the survey answered in a truthful manner is a limitation. It is assumed that all people answered without pre-determined biases. Such factors, if they occurred , are beyond the control of this author.

### **Definitions**

Apparatus – a vehicle utilized for transportation of firefighters and equipment to a fire, rescue, or medical scene. The piece of equipment may be specialized or multi-functional.

Candela – Measurement of light intensity. The luminous intensity.

Emergency Vehicle – A generic term used in this report to describe a vehicle such as a fire truck, or rescue squad.

## **RESULTS**

### **What colors are commonly used for fire apparatus?**

The colors of fire apparatus are variable throughout the world. Color combinations and various shades of a color are as wide as the imagination. However, it has been found through research and survey, that the color red is the prominent choice for fire apparatus. There are a variety of shades of red and combinations of red with other colors, but the main color of the apparatus is red. Approximately 85% of all new apparatus manufactured today are a variation of the color red. The other 15% are of whites, yellow, lime-green, lime-yellow and black. Many departments went to the lime-green and yellow colors in the 1970's as a result of a study by Dr. Soloman. However, the current trend is to phase these colors out and go back to red.

### **What financial benefits do fire apparatus gain by using the color red?**

Fire departments can make a positive financial gain on their budgets by using the color red for their fire apparatus. This can happen in two ways. The first way is through resale of the fire apparatus. Because more departments are using red as the color of their fire apparatus, there is a larger market for red fire apparatus. This will help enhance the sale of the apparatus when the decision is made to sell the apparatus. If other colors are chosen, the unit may have to be repainted before resale at a cost to the seller.

Another reasons for financial gain is in the area of maintenance. The lime-green and lime-yellow colors tend to fade over the years. Scratches and dents are more readily seen. To keep the fire apparatus in good visual shape requires on-going maintenance. The cost of the fire apparatus maintenance will be lowered by using red.

**Is the color red a possible cause for accidents, or are there other causes which fire departments should address?**

Fire departments need to address other causes of accidents. The cause most written about, and the cause that will have the most profound result of lowering or eliminating accidents are emergency vehicle operator training programs.

Emergency Vehicle Operator training is by far the best use of resources available for eliminating accidents. A certified training program, complete with classroom, hands-on training, and a record keeping course will help eliminate accidents and reduce the liability of the fire department when a fire apparatus is involved in an accident. By following NFPA 1002 consensus standard for operator training and NFPA 1451 for setting up a training program, a comprehensive program dedicated to safe driving can be developed. According to Sorensen (Dec. 2000), "The programs should be expanded to include actual driving of individual apparatus in simulated conditions which challenge the equipment and the skills of the driver (p.25).

**What new technology exists to make fire apparatus more visible?**

New technology in the area of visibility of fire apparatus has improved over the last 30 years and is improving at a more rapid pace today as science advances in the use of computers and micro-technology.

The uses of retroreflective adhesive materials on fire apparatus are required by NFPA 1901 and have improved immensely in the past years. The use of a white material is a much wiser choice than black. White is 10 times more reflective than black.

Light technology has made rapid advances in strobe and halogen lighting. LED technology is also advancing. Being able to emit 1,000,000 candelabras is part of the NFPA 1901. The use of the halogens with strobes can make the apparatus meet this standard. By providing an optimum

flash rate of 200 flashes/min., the visibility of the fire increases for the viewer. Combined good emergency lighting with safe driving skills, and the apparatus becomes a much safer vehicle.

## **DISCUSSION / IMPLICATIONS**

The result of informational fact findings involving the visibility of emergency vehicles reveals trends in color choice, new technology, and training programs that some fire departments use to have a safe responding emergency vehicle. The results also show what happens when the training programs and consensus standards are not followed.

The color red was found to be the color of choice for the majority of fire department apparatus across the country and that it does not have an impact on the accident rate of emergency vehicles. Rather it was found to have an impact on the financial area of the fire department operational budget. The resale of the red fire apparatus at the end of its use would tend to bring in more revenue than an apparatus painted a color other than red. The visual appearance of the apparatus will also be of better quality than that of the lime-green or lime-yellow colors. Characteristics of red paint, such as less fading and the ability of the color red to make scratches and smaller dents less visible, is another reason fire department managers are going back to this color. Other items such as good lighting, following the NFPA 1901 using the standard for light emissions, combined safe driving practices, and following NFPA 1002 and NFPA 1451 are what keep the accident rates low.

As stated in NFPA 1451 (1997), "Every fire department shall have some type of EVO training program" (p. 1451-5). It has been found through an informational survey that many fire departments do use some type of EVO program. However, this has not always been true. Some departments such as Birmingham, AL were without an EVO program for many years. Prior to 1997, the Birmingham Fire Department experienced accident rates that were unacceptable to the fire management officials in their city (App. E). As a result, a comprehensive EVO program was

initiated. The accident rate has declined to zero and remains that way to the date this paper was written.

The long term goal of the fire department is to respond to the emergency in a safe and rapid manner. To injure, or kill a citizen or firefighter in response to the emergency, or to damage a \$250,000 fire apparatus beyond repair, would be totally unacceptable. The lawsuit settlement, if the fire department was found to be at fault for causing the accident, would cost far more than the EVO training program, and the department would still be forced to repair the apparatus and absorb this cost in the fire department budget. Rossman (1995) states, "The only way to lower this risk is to institute a bona-fide training program."

New technology in the area of lighting is one of the areas that has and is continuing to improve as advancement in science takes place. By following the minimum standards according NFPA 1901, the visibility of the fire apparatus will continue to improve. Just as it is important for all new fire apparatus to follow the standard, the departments should update the older equipment. The visibility of the older equipment, when responding in the emergency mode, should also be a priority of fire administrators.

The results of this research project present several implications for fire administrators and Executive Fire Officers. First, the color of the apparatus should be looked at closely and the department should choose a color that meets budgetary and safety needs of the department. Secondly, the departments should review the emergency vehicle operator class. Examine the current NFPA 1002 and NFPA 1451 standards and see if their individual departments comply or exceed these standards. Third, the department should review NFPA 1901 and evaluate the light emissions of the departments fire apparatus. Any deviations from this standard should be eliminated by adding new lighting devices. This will include halogen, strobe, and LED lighting.

Following the above items will lead the department to more visible and safer emergency fire apparatus.



## RECOMMENDATIONS

It was proven that red fire apparatus are no more prone to causing accidents than other colors of apparatus. Painting a fire apparatus red will not reduce the visibility of the fire apparatus, and may have a positive influence on the fire department budget. Fire chiefs, Executive Fire Officers, and city administrators should be aware of this fact and that several other issues demand a higher priority in the area fire apparatus visibility and safety.

Senior fire officials should examine the long term goal of the fire apparatus. Will the unit be for sale after so many years of service? Or, will the unit be completely worn out and not of much value? If the unit is to be resold, thought should be given to painting the apparatus red because of the higher resale value in the future. If it to be used until it is worn out, the color will be a budgetary issue.

When ordering new apparatus, care should be taken to follow the recommendations of NFPA 1901 *Standard for Automotive Fire Apparatus*. By following these standards, a more visible fire apparatus can be delivered to the fire department. Insuring that the apparatus emits the minimum required 1,000,000 candelas and installs a quality four inch retroreflective material will ultimately determine the true visibility of the vehicle.

However, no matter how visible the apparatus, poor driving will ultimately lead to more accidents. Therefore, meeting or exceeding NFPA 1002 *Standard Fire Apparatus/Driver/Operator Professional Qualifications* and NFPA 1451 *Standard for a Fire Service Vehicle Operations Training Program* will help reduce the chance of operator error. In addition to the accident rate decrease, the repair of the apparatus and the possibility of very high legal fees and binding lawsuits will also decrease. By not providing competent training, fire officials and city officials pass this burden to the tax payers.

It is imperative that fire officials educate the city administrators about fire apparatus safety. They must teach the need for an EVO program by showing the results of other cities with programs in place. Above all, they must show the financial impact a competent EVO training program can have in the area of reducing accidents and the amount of money spent on lawsuits, medical bills for injured employees, and vehicle repairs when the apparatus becomes involved in and is the cause of an accident. The overall result will be providing a better service to the citizens of the community.

## REFERENCES

Kamrath, Dale S. (1991). Red Fire Trucks – Tradition or Recognition, Applied Research Paper, National Fire Academy, Emmitsburg, MA.

National Fire Protection Association. (1999). NFPA 1002 Standard for Fire Apparatus/Driver/Operator Professional Qualifications, 1998 edition. Quincy, MA: NFPA.

National Fire Protection Association. (1997). NFPA 1451, Standard for a Fire Service Vehicle Operations Training Program, 1997 edition. Quincy, MA: NFPA.

National Fire Protection Association. (1999). NFPA 1901, Standard for Automotive Fire Apparatus, 1999 edition. Quincy, MA: NFPA.

Rossman, Neil. (1995 February). Emergency vehicle accidents: A legal perspective.

Soloman, Steven S. (1974, August). Fire Apparatus Color – What are Current Trends and Applications?. Fire Command, , p. 43-47.

Soloman, Steven S. (1990, November). Journal of the American Optometric Association, p. 827.

Sorensen, Brian E. (2000, December). The Need for an Emergency Vehicle Operating Training Program, Applied Research Paper, National Fire Academy, Emmitsburg, MD.

3M Corporation. (2001). Fleet Vehicle Marking. *Government Vehicle Markings*. Retrieved May 24, 2001 from the 3M Database on the World Wide Web.  
<http://www.3M.com/market/trans/tcm/pc/gvm/chartLEV.html>.

## APPENDIX A

### Break-down of colors used in the Fire Service by Prominent Manufactures

#### Emergency One

Jeff Mellen President EDM  
1-800-793-3473

Red	86%
Lime-green	5.5%
white	4.0%
All other	4.5%

#### Toyine

Dave Farnell- Director of Marketing  
1-800-648-3358

Red	85%
All others	15%

#### American La France

George Logan  
1-815-772-7139

Overwhelming Majority - Red  
("No official record kept")

**APPENDIX B****Colors of Apparatus sold in Oregon in 1991**

<b><u>COLOR</u></b>	<b><u>AVERAGE % MANUFACTURED</u></b>
Red – Red/White	70%
Lime-green & Lime-yellow	10%
White	10%
Others	10%

## APPENDIX C

### Omaha Metropolitan Area Fire Department Apparatus Colors

#### Douglas County

#### Sarpy County

Omaha	Red ( <u>all new</u> )/Yellow (old)	La Vista	Red
Ponca Hills	Red	Papillion	White
Irvington	Red	Bellevue	Red
Bennington	Yellow	Springfield	Red
Boystown	White	Gretna	Red
Elkhorn	White/red stripe		
Waterloo	Red		
Valley	Red/Black		

13 Departments surveyed

Red	9/13	69%
White	3/13	23%
Yellow	1/13	1%

## APPENDIX D

### 3M Government Vehicle Retroreflective Marking Tape

#### Flexible

580-10 White	100	For production of multicolor vehicle emblems and markings. The flexibility of these sheetings makes them well suited for application over curves with rivets, corrugations with rivets, flat or curved surfaces, even in cold climates.	4400 Transparent (See Product Bulletin 4400) 9700 U.V. 3900 Opaque (See Information Folder 4.11)	Vehicle body with compound curve, rivets, flat. (See Information Folder 4.3)	Pressure sensitive (Min. 55° F) 13° C
580-14 Orange	25				
580-64 Gold	65				
580-71 Yellow	60				
580-72 Red	20				
580-75 Blue	10				
580-76 Light Blue	10				
580-77 Green	15				
580-81 Lemon Yellow	40				
580-82 Ruby Red	20				
580-85 "C" Black	30				
580-82 Ruby Red	20				
580-85 "C" Black	30				

## **APPENDIX E**

### **City Survey Questions**

1. What is the color of fire apparatus used by your department?
2. Does your department have a competent EVO course given to all fire apparatus drivers?
3. How many runs did your department make in 1999?
4. How many accidents involving fire apparatus occurred in 1999?



## APPENDIX F

### City Survey Responses

City	Color	EVO Class	Runs in 1999	Acc. 1999	%
Birmingham, AL	Yellow	No	1800	3	0.0015
Birmingham, AL	Yellow	yes	1896	0	0
Fremont, NE	Red	yes	1600	0	0
Helena, MT	Red	yes	2648	0	0
Marin Co. FL	Red	yes	14,000	4	0.0003
Redmond, WA	Red	yes	6,500	5	0.0008
Los Angeles, CA	Red	yes	596,753	520	0.0009
Birmingham, VT	Red	yes	2400	5	0.002
Deerfield, OH	Red	yes	2700	1	0.0004
Rocky Mount, NC	Red	yes	2500	0	0
Queensland, Australia	Red	yes	30,000	80	0.0003
Peoria, AZ	Red	yes	7945	0	0
Chicago, IL	Red	No	100,000	112	0.013

## APPENDIX G

### Recommendations

1. Senior fire officials should examine the long term goal of the fire apparatus. Will the unit be for sale after so many years of service? Or, will the unit be completely worn out and not of much value? If the unit is to be resold, thought should be given to painting the apparatus red because of the higher resale value in the future. If it to be used until it is worn out, the color will be a budgetary issue.
2. When ordering new apparatus, care should be taken to follow the recommendations of NFPA 1901 *Standard for Automotive Fire Apparatus*. By following these standards, a more visible fire apparatus can be delivered to the fire department. Insuring that the apparatus emits the minimum required 1,000,000 candelas and uses a quality 4" retroreflective material will ultimately determine the true visibility of the vehicle.
3. Meeting or exceeding NFPA 1002 *Standard Fire Apparatus/Driver/ Operator Professional Qualifications* and NFPA 1451 *Standard for a Fire Service Vehicle Operations Training Program* will help reduce the chance of operator error.
4. It is imperative that fire officials educate the city administrators about fire apparatus safety. They must teach the need for an EVO program by showing the results of other cities with programs in place. Above all, they must show the financial impact a competent EVO training program can have in the area of reducing accidents and the amount of money spent on lawsuits, medical bills for injured employees, and vehicle repairs when the apparatus becomes involved in and is the cause of an accident.